

REMARKS

Careful consideration has been given by the applicant to the Examiner's comments and rejection of the claims, as set forth in the outstanding Office Action, and favorable reconsideration and allowance of the application, as amended, is earnestly solicited.

Applicant notes the Examiner's rejection of Claims 1, 3, 5, 9, 11, 12, 14, 16, 20 and 22 as being rejected under 35 U.S.C. §103(a), as being unpatentable over Walker, et al., U.S. Patent No. 6,275,277 B1 in view of Lee, U.S. Patent No. 6,844,911 B2, as detailed in the Office Action.

Furthermore, applicant notes the Examiner's rejection of Claims 4, 7, 8, 15, 18 and 19 as being unpatentable over the art applied to the preceding claims and further in view of Liao, et al., U.S. Patent No. 6,681,005 B2; the rejection of Claims 6 and 17 as being unpatentable in view of the art applied to the first set of rejected claims and further in view of Cohn, U.S. Publication No. 2002/0179921 A1; and the rejection of Claims 10 and 21 as being unpatentable over the art applied to the first set of rejected claims and further in view of Brosig, et al., U.S. Patent No. 5,106,441, all of these grounds of rejection being discussed in extensive detail in the Office Action.

However, applicant respectfully takes issue with the Examiner in applying the art, which although superficially similar to the present invention, both as to the description and the drawings, relates to entirely different methods and products in obtaining the spacerless filling of liquid crystals to form liquid crystal cells on a silicon backplane or microdisplay.

Applicant further notes the Examiner's rejection of Claims 1-3, 5, 9, 12-14, 16 and 20 under 35 U.S.C. §103(a), as being unpatentable over Sojourner, et al., U.S. Patent No. 6,750,939 B2 in view of Lee, U.S. Patent No. 6,844,911 B2, as detailed in the Office Action.

Accordingly, in order to clearly and unambiguously distinguish over the art, irrespective as to whether the latter is considered singly or in combination, applicant has amended the claims to more clearly emphasize the distinctions with regard to the invention being directed through novel spacerless filling of liquid crystals cells on silicon backplanes or microdisplays.

In order to more clearly emphasize the foregoing, appropriate amendments have been implemented to Claims 1 and 12, respectively, the method and arrangement for the spacerless filling of liquid crystals.

The inventive method and the arrangement obtained thereby is not in any manner disclosed nor suggested by the art of record, irrespective as to whether the prior art publications are considered singly or in combination.

Hereby, in traverse of the rejection of the claims, applicant respectfully submits the following comments in view of the prior art:

Walker, et al., sets forth that the spacers are maintained away from the active area of the display. However, the top layer material 155 is laminated to the silicon backplane (Fig. 10) first, and then pressed with a conformal bag to flatten the assembly (Figs. 11, 12 and 14) and the sealant cured to form empty display cells. Figs. 16 and 17 of Walker, et al. depicts the method of vacuum injection of the preformed display cells in the liquid crystal bath. The liquid crystal is injected into the cavity through the opening, not by DISPENSING onto the substrate. The amount of the liquid crystal is not exact, usually is more than the actual needed amount and the display cell is bowed up. After the assembly is diced and separated, the excessive amount of liquid crystal will then be squeezed out by a press operation before the port is sealed (Figs. 32 and 33). This method in Walker, et al. is different from the method

disclosed in the present application. In applicant's teaching, the EXACT AMOUNT of liquid crystal material is dispensed onto the substrates after the sealant is dispensed, but BEFORE the top substrate is laminated. The top substrate is laminated with not only sealant, but also with liquid crystal material dispensed as well. Applicant notes that the sealant pattern in teaching the present invention is a fully closed pattern without the opening for filling. The display process is complete after dicing and separation process. The advantages of this invention are (1) the substrates are laminated without any cavity to ensure better cell gap uniformity; (2) the liquid crystal vacuum injection process is eliminated; and (3) the cell press and end seal process are eliminated. This inventive feature is not obvious from the method of Walker, et al.

In addition, it is emphasized by applicant that the sealant 150 in Walker, et al.'s patent is not the same "spacer wall" as in the present application, whereas the Examiner has apparently inadvertently misinterpreted applicant's concept of spacer wall with a sealant that contains spacers. The spacer wall in the present application does not have to have the function of sealant or glue, as it can be only a barrier made out of inorganic material in between the active area of the display and sealant to prevent or delay the contaminants from the sealant diffusing into the active area. The sealant 150 in Walker, et al. functions to seal and glue the substrates together and is in direct contact with liquid crystal without any interposed barrier layers.

In Lee, U.S. Patent No. 6,844,911 B2, similar to Walker, et al., liquid crystal is vacuum filled after the substrates are laminated. The sealants in Lee's patent do not serve as a spacer wall, it is barely a means of mechanical support during the substrate lamination process, and is not part of the display while being cut off during the dicing process. The

sealant in the present application, to the contrary, is an important part of the final display cell and will remain with the display in order to glue and seal the two substrates together.

Liao, et al., U.S. Patent No. 6,681,005 B2 is basically similar to the teaching of Lovas, as set forth hereinbelow. Again, the liquid crystal is filled after the joining of the substrates. Hereby, Lovas, U.S. Patent No. 6,126,768 discloses a method of joining two display substrates together by applying pressure on the peripheral area of the display where the spacer walls are located. However, in the teaching of Lovas, the substrates are joined without any liquid crystal materials in between. In other words, the LCD cells are empty when the pressure is applied and the sealant is cured, whereby the emptiness of the cell renders it difficult to obtain a uniform cell gap, while the present invention overcomes this problem and reduces the process time for the arranging and filling of tiny microdisplay.

Cohn, U.S. Publication No. 2002/0179921 A1 pertains to a compliant seal for holding substrates with different thermal expansion coefficients. Although the compliant seal disclosed by Cohn is formed by photolithography means, the function thereof is to effect a sealing action. As is common knowledge, the seal is to protect the device located within the seal from external environmental damages. The function of applicant's spacer walls, however, is to prevent the contamination from the seal material itself entering into the liquid crystal. The present invention's type of spacer walls is not obvious from the cited patent.

Finally, Brosig's method of forming displays by dispensing sealant and liquid crystal material and then laminating the substrate together is somewhat similar to the present method. However, one of the problems with Brosig's method is that the uncured sealant, which contains radicals that are harmful to liquid crystal, are in contact with the liquid crystal and cause a reliability problem. The problem is even worse for microdisplays where the size of

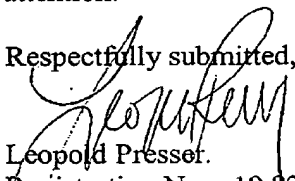
the display is so small that the distance from sealant to active area is frequently less than 1mm. The introduction of the spacer walls pursuant to the invention solves the problem, improves the image quality and extends the service life of the display.

Concerning the foregoing, after clearly and precisely reviewing the prior art, it is quite apparent that although superficially there appear to be appearances in the drawings of the various patents and those of the present application which can be misconstrued by a cursory review of the art, there are clear and unambiguously provided patentable distinctions, as set forth hereinabove and as also brought forth in the amended claims presented herein.

It is the present invention that provides for the advantages in the art concerning the spacerless filling of the liquid crystals to form liquid crystal cells, and this particular aspect is not at all ascertainable nor accomplished in any of the references of record.

In view of the foregoing amendments to the claims and supporting arguments, which clearly emphasize the distinctions over the art, the early and favorable consideration and allowance of the application, as amended, is earnestly solicited. However, in the event that the Examiner has any queries concerning the instantly submitted Amendment, applicant's attorney respectfully requests that he be accorded the courtesy of possibly a telephone conference to discuss any matters in need of attention.

Respectfully submitted,


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